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TITLE: SKIN SURFACE OBSERVATION APPARATUS

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INVENTOR-INFORMATION:
NAME
KOJIMA, NOBUTOSHI
HOTTA, HAJIME

ASSIGNEE-INFORMATION:

NAME	COUNTRY
KAO CORP	N/A

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ABSTRACT:

PURPOSE: To obtain a skin surface observation apparatus wherein the observation operation is simplified when a skin surface is observed by emitting independently a polarized light S and a polarized light P on the skin and on the reflected light from the skin to each emitted light, receiving also separately both a polarized light S component and a polarized light P component.

CONSTITUTION: A skin surface observation apparatus is provided with an emitting means for emitting a polarized light S or a polarized light P on the surface of a skin, a liq. crystal cell 10 wherein a reflected light of a light emitted on the skin from the emitting means is received and the

polarization direction of
the transmitted light is changed by applying an electric
voltage, a polarized
light filter 13 for receiving a transmitted light through the
liq. crystal cell
10 and transmitting a polarized light S or a polarized light
P and a
photographing apparatus 14 receiving the polarized component
transmitted
through the polarized light filter 13.

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English Translation

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]
[Industrial Application] Using the polarization property of light, this invention acquires separately surface reflected light pictures, such as a ripple of the skin, and pore, and the reflected light picture inside the skins, such as a stain and a freckle, faces them carrying out analysis evaluation of the skin front face based on it, and relates to suitable skin surface observation equipment.

[0002]
[Description of the Prior Art] In order to make up foundation etc. to the skin and to obtain the desired skin, the correspondence relation between the correspondence relation between the texture (say how the skin is visible to an observer) of the skin and the physical characteristic of the skin, the kind of makeup, an amount, and the physical characteristic of the skin which gave makeup is analyzed, and it is effective to define the makeup which should be given to the skin concerned. Therefore, it is made by the method various in analyzing and evaluating a skin surface state called irregular colors, such as a stain inside states, such as a ripple on the front face of the skin, and pore, or the skin, and a freckle, from before.

[0003] Although there is also a method of only carrying out photomacrography of the skin and analyzing a skin surface state on the basis of the picture as a method in this case, it cannot dissociate and this method cannot estimate [can analyze skin surface states, such as a ripple and pore, and skin internal states, such as a stain and a freckle, and] them. Therefore, in order to analyze states, such as a ripple and pore, separately from irregular colors, such as a stain and a freckle, and to enable it to evaluate them, the method of using polarization is proposed (JP,2-206426,A etc.).

[0004] That is, as shown in drawing 7 , it is the natural light LI to Skin S. If incidence is carried out, the part is reflected on a skin front face (surface reflected light LS), and others will be refracted inside the skin, will repeat dispersion and absorption, and they will carry out outgoing radiation from a skin front face again (internal reflection LD). In this case, the surface reflected light LS has the information on the front face of the skin (concavo-convex information, refractive index), and is internal reflection LD. It has the information inside the skin (the color of the skin, irregular color). Moreover, the surface reflected light LS When the natural light LI which carried out incidence has

predetermined plane of polarization, it is an incident light LI. Although reflected as the linearly polarized light of the same plane of polarization, it is internal reflection LD. Polarizability was lost.

[0005] Then, in above-mentioned JP,2-206426,A, as shown in drawing 6 , the skin surface observation equipment which prepared the polarizing filter in the illuminating system and the light-receiving system inside equipment, respectively is used, and a skin front face is observed as follows. In the equipment of drawing 6 , it has the ring-like lighting system 3 which injects the light which carried out the light guide to the inner circle wall of the cylinder-like main part 1 by the optical fiber 2 from the light source, and the polarizing filter 4 for floodlighting of the disk configuration which has the centrum of a concentric circle is formed in the front face of a nose of cam of the ring-like lighting system 3. Moreover, the observation pore 5 has opened in the point of a main part 1, the polarizing filter 6 for light-receiving is formed in the center near the nose of cam of a main part 1, and the expansion objective lens system 7 is formed behind this polarizing filter 6 for light-receiving. Furthermore, image pck-up equipment (not shown) is formed in the latter part of the expansion objective lens system 7, and the surface observation image received by image pck-up equipment is outputted to a monitor through a signal cable 8. And it is made, as for the polarizing filter 6 for light-receiving, for the polarization directions to differ to the polarizing filter 4 for floodlighting in this case. At the time of use of this equipment, first, the skin is made to contact the observation pore 5, polarization is irradiated through the polarizing filter 4 for floodlighting at the skin from the ring-like lighting system 3, the reflected light is received with image pck-up equipment through the polarizing filter 6 for light-receiving, and the picture of the skin is formed. Thus, if a skin front face is observed, since the polarization directions of the polarizing filter 4 for floodlighting and the polarizing filter 6 for light-receiving differ, the light received with image pck-up equipment becomes that into which the direct reflected light on the front face of the skin was cut, and the picture of the skin mainly comes to be formed based on internal reflection. Therefore, states, such as a stain and a freckle, come to be acquired more clearly than the case where the polarization direction of the polarizing filter 4 for floodlighting and the polarizing filter 6 for light-receiving is made the same.

[0006]
[Problem(s) to be Solved by the Invention] However, in the observation method on the front face of the skin of having used the conventional polarization, since the picture based on internal reflection was formed in above-mentioned JP,2-206426,A like the method of a publication only based on the light of the one polarization direction, there was a problem that the skin may be unable to be analyzed accurately and may be unable to be evaluated based on the picture from which the picture acquired was acquired unlike actual texture.

[0007] That is, the light used as the light source is usually the natural light. The natural light is a unpolarized light, S polarization (polarization which has a plane of vibration perpendicular to plane of incidence), and P polarization (polarization which has a plane of vibration parallel to plane of incidence) are included by the same intensity, and an

observer will receive the reflected light of these both sides, and will take in the texture of the skin. On the other hand, although the reflectivity of S polarization and P polarization differs greatly according to an incident angle, for example, S polarization shows a considerable reflection factor with a specific incident angle, P polarization is not reflected at all. Therefore, the picture and texture by which the picture formed based on either S polarization or P polarization is actually observed will differ from each other.

[0008] On the other hand, this invention person used the both sides of S polarization and P polarization as a light which do incidence to the skin as a method of observing a skin front face using polarization, and proposed the method of receiving the reflected light to each incident light separately about the both sides of S polarization component and P polarization component (a Japanese-Patent-Application-No. No. 247523 [five to] specification, claim). According to this method, the surface reflected light component and internal reflection component of the skin at the time of making the natural light into an incident light can be computed, the surface reflected light picture and internal reflection picture of the skin equal to actual texture can be acquired by this, and it becomes possible to carry out analysis evaluation of the feature on the front face of the skin more proper.

[0009] However, in this method, since two sorts of polarization is used as an incident light to the skin and two sorts of polarization components are received about each of each incident light as the reflected light from the skin, it is necessary to obtain light-receiving data about the combination of a total of four kinds of incident lights, and the reflected light. Therefore, in enforcing this method with the conventional equipment shown in drawing 6 , whenever it obtains each light-receiving data, the polarizing filter for floodlighting or the polarizing filter for light-receiving must be changed, or you have to carry out mechanical operation of changing the sense. Therefore, there was a problem that observation operation became very complicated.

[0010] As a method of observing a skin front face so that this invention may solve the technical problem of such conventional technology and surface reflected light pictures, such as a ripple on the front face of the skin and pore, and the reflected light picture inside the skins, such as a stain and a freckle, can be acquired separately When carrying out incidence of S polarization and the P polarization to the skin separately and receiving S polarization component and P polarization component separately also as the reflected light from the skin to each incident light S polarization component and P polarization component of the reflected light to the incident light which has the one polarization direction Without carrying out mechanical operation of a polarizing filter, it enables it to receive light, respectively and aims at offering the skin surface observation equipment which enables it to enforce the observation method on such a front face of the skin simple.

[0011]
[Means for Solving the Problem] If the liquid crystal device which makes either the liquid crystal cell which changes the polarization direction of the transmitted light of a twist to impression of voltage, S polarization component or P polarization component penetrate is used in case this invention persons receive the reflected light at the time of

making a skin front face carry out incidence of S polarization or the P polarization, they will find out that the above-mentioned purpose can be attained, and they came to complete this invention.

[0012] Namely, the irradiation means to which this invention can make a skin front face carry out incidence of S polarization or the P polarization, The liquid crystal cell which receives the reflected light of the light which carried out incidence to the skin from this irradiation means, and changes the polarization direction of the transmitted light by impression of voltage, The skin surface observation equipment characterized by having image pck-up equipment which receives the light which penetrated this liquid crystal cell, and receives the polarization component which penetrated the polarizing filter and this polarizing filter which make S polarization or P polarization penetrate is offered.

[0013]
[Function] In the skin surface observation equipment of this invention, the reflected light on the front face of the skin is first received by the liquid crystal cell which changes the polarization direction of the transmitted light by impression of voltage, and the light which penetrated this liquid crystal cell is received with image pck-up equipment through a polarizing filter. therefore, when for example, TN cell is used and voltage is impressed to a liquid crystal cell as this liquid crystal cell While S polarization component and P polarization component of the reflected light in the skin of the incident light (for example, incident light of S polarization) of the one polarization direction had maintained the original polarization direction, a liquid crystal cell is penetrated. Carry out incidence to a polarizing filter, a polarizing filter makes a predetermined polarization component (for example, S polarization component) penetrate, and the transmitted light is received with image pck-up equipment. Moreover, since the light which penetrated the liquid crystal cell changes the polarization direction in not impressing voltage to a liquid crystal cell, S polarization component of the reflected light in the skin turns into P polarization component, a liquid crystal cell is penetrated, and P polarization component of the reflected light turns into S polarization component, and penetrates a liquid crystal cell, for example. After that, only a predetermined polarization component (for example, S polarization component) penetrates a polarizing filter, and the transmitted light is received with image pck-up equipment. Therefore, the light received with image pck-up equipment serves as a reflected light component (for example, P polarization component) which has the different polarization direction from the polarization component which penetrated the polarizing filter essentially.

[0014] Thus, according to the skin surface observation equipment of this invention, although image pck-up equipment will receive the light of the predetermined polarization direction (for example, S polarization) always specified with a polarizing filter, according to the existence of impression of the voltage to a liquid crystal cell, either S polarization component of the reflected light or P polarization component can receive it essentially. Therefore, S polarization component and P polarization component of the reflected light can be received simple only by being based on the existence of impression of the voltage to a liquid crystal cell, without carrying out mechanical operation of a polarizing filter.

[0015] If the cylinder-like lighting system which injects the light by which the light guide was carried out from the light source as an irradiation means to which incidence of S polarization or the P polarization can be carried out especially, the polarizing filter for floodlighting, and the liquid crystal cell which changes the polarization direction of the transmitted light to the latter part of the polarizing filter for floodlighting by impression of voltage are prepared, the polarization direction which carries out incidence to the skin by the existence of impression of voltage is changeable. Therefore, it becomes completely unnecessary to use the both sides of S polarization and P polarization as an incident light, to change a polarizing filter within equipment in performing the observation method on the front face of the skin of receiving the reflected light to each incident light separately about the both sides of S polarization component and P polarization component, or to perform mechanical operation of change of the sense, and observation operation becomes remarkably simple.

[0016]
[Example] Hereafter, the example of this invention is concretely explained based on a drawing. In addition, the same sign expresses the same or equivalent component among each drawing.

[0017] Drawing 1 is equipment I of one example of this invention. It is a partial notch cross section and drawing 2 is the general drawing of the system which performs skin surface observation using the equipment of drawing 1 .

[0018] equipment I of drawing 1 **** -- the ring-like lighting system 3 which injects the light which carried out the light guide to the inner circle wall of the cylinder-like main part 1 by the optical fiber 2 from the light source 9 like the equipment shown in drawing 6 as an irradiation means is formed Moreover, the polarizing filter 4 for floodlighting of the disk configuration which has the centrum of a concentric circle is formed in the front face of a nose of cam of the ring-like lighting system 3, and the observation pore 5 has opened in the point of a main part 1.

[0019] The liquid crystal cell 10 is formed in the center near the nose of cam of a main part 1, and operation of this liquid crystal cell 10 is controlled by the liquid crystal cell control section 11 through the cable 12 for control. As a liquid crystal cell 10, the thing which makes either S polarization component or P polarization component penetrate by impression of voltage is prepared. As such a liquid crystal cell, TN cell etc. can be prepared, for example.

[0020] The polarizing filter 13 is formed in the latter part of a liquid crystal cell 10, and CCD camera 14 is further formed in the latter part as the expansion objective lens system 7 and image pck-up equipment. The picture signal from this CCD camera 14 is sent to the CCD camera-control section 15 through a signal cable 8, and is further inputted into the image-processing section 16 of the latter part. This equipment I On the occasion of use, the skin surface observation method indicated by the claim of an above-mentioned Japanese-Patent-Application-No. No. 247523 [five to] specification is followed, for example. When surface observation of the skin is performed by carrying out incidence of

S polarization and the P polarization to the skin, respectively, and receiving the reflected light to each incident light separately about the both sides of S polarization component and P polarization component, First, according to any shall be irradiated between S polarization or P polarization, the polarizing filter 4 for floodlighting is suitably chosen as the skin to observe, and it sets to the predetermined sense. And the skin is made to contact the observation pore 5 and predetermined polarization (for example, P polarization) is irradiated through the polarizing filter 4 for floodlighting at the skin from the ring-like lighting system 3. Moreover, according to the polarization component which should receive light by CCD camera 14, the existence of impression of the predetermined voltage to a liquid crystal cell 10 is controlled by the liquid crystal cell control section 11.

[0021] For example, as shown in drawing 3 , incidence of the P polarization is carried out to Skin S as a polarizing filter 4 for floodlighting using P polarizing plate. When P polarizing filter is used also as a polarizing filter 13 of the latter part of a liquid crystal cell and it is going to receive P polarization component of the reflected light from Skin S by CCD camera 14 Predetermined voltage is impressed to a liquid crystal cell (TN cell) 10, and it is made for the light which penetrated the liquid crystal cell 10 to have the same plane of polarization as the light which carried out incidence to the liquid crystal cell. Thereby, the reflected light in Skin S penetrates a liquid crystal cell 10, while S polarization component and P polarization component had also maintained the polarization direction, it carries out incidence to a polarizing filter 13, and only P polarization component penetrates a polarizing filter 13, and it comes to be received by CCD camera 14. When it is going to receive S polarization component of the reflected light from Skin S by CCD camera 14 in the same equipment configuration, impression of the voltage to a liquid crystal cell (TN cell) 10 is stopped, and it is made for the light which penetrated the liquid crystal cell 10 to, have different plane of polarization (for example, plane of polarization of the direction rotated 90 degrees) from the light which carried out incidence to the liquid crystal cell on the other hand, as shown in drawing 4 . Thereby, S polarization component serves as P polarization after transparency of a liquid crystal cell 10 among the reflected lights in Skin S, and P polarization component serves as S polarization after transparency of a liquid crystal cell 10, and carries out incidence to a polarizing filter 13. And only P polarization (S polarization component of original of the reflected light) penetrates a polarizing filter 13, and comes to be received by CCD camera 14. Thus, P polarization is irradiated at Skin S and it is S polarization component [of the reflected light in that case] I (ps). P polarization component I (pp) Light-receiving data are obtained.

[0022] Moreover, S polarization component [of the reflected light at the time of irradiating S polarization at the skin by repeating the above operations, as the polarizing filter 4 for floodlighting serves as S polarizing plate] I (ss) P polarization component I (sp) Light-receiving data are also obtained.

[0023] CCD camera 14 will input the picture signal into the image-processing section 16, if the light which penetrated the polarizing filter 13 is received. Four-sort light-receiving data I obtained in this way in the image-processing section 16 (ss) I (sp) I (ps) I (pp) It is based, and asks for on-the-strength [of the surface reflected light component at the time

of carrying out incidence of the natural light to Skin S] I (S) by the formula (9)) of the following Japanese-Patent-Application-No. [(Formula A) (] No. 247523 [five to] specification, and a surface reflected light picture is formed.

[0024]
[Equation 1]
I(S)=(I(pp) -I(ps))+(I(ss) -I(sp)) (A)
Moreover, it asks for on-the-strength [of the internal reflection component at the time of carrying out incidence of the natural light to the skin] I (D) by the formula (10)) of the following Japanese-Patent-Application-No. [(Formula B) (] No. 247523 [five to] specification, and an internal reflection picture is formed.

[0025]
[Equation 2]
I (D) =2andI (ps) +2andI (sp) (B)
The equipment II of drawing 5 is a modification at the time of constituting from a liquid crystal cell 17 which changes the polarization direction of the transmitted light by the cylinder-like lighting system 3 which injects the light by which the light guide was carried out from the light source in the irradiation means, the polarizing filter 4 for floodlighting, and impression of voltage in the example of above-mentioned drawing 1 . TN cell etc. can be used as such a liquid crystal cell. Although the polarization direction of the light irradiated by the skin will turn into the polarizing filter 4 for floodlighting, and a direction rotated 90 degrees in not impressing voltage to a liquid crystal cell 17 if TN cell is used as a liquid crystal cell 17 and the thing which makes S polarization or P polarization penetrate as a polarizing filter 4 for floodlighting is used in this irradiation means, if voltage is impressed, it will become the same direction as the polarizing filter 4 for floodlighting. Therefore, even if it does not carry out mechanical operation of changing the polarizing filter 4 for floodlighting for the skin according to whether S polarization is irradiated or P polarization is irradiated, or changing the sense, it becomes possible to irradiate both S polarization and P polarization to the skin by on of the applied voltage to a liquid crystal cell 16, and off. Therefore, incidence of S polarization and the P polarization is carried out to the skin, respectively, and it becomes possible by receiving the reflected light to each incident light about the both sides of S polarization component and P polarization component to perform observation operation in the case of performing surface observation of the skin with a sufficient precision still simpler.

[0026] In addition, in the above example, although the case where the equipment of this invention was applied to the skin surface observation for acquiring separately surface reflected light pictures, such as a ripple on the front face of the skin and pore, and the reflected light picture inside the skins, such as a stain and a freckle, was explained, the equipment of this invention is not restricted to this, but is applicable to surface observation of the various skins. Since it is especially easy to move an observed object, it is 4 sorts of light-receiving data I (ss). I (sp) I (ps) I (pp) It can be suitably used as observation equipment when it is difficult to measure individually, for example, can be used as medical-application cameras, such as gastrocamera.

[0027]
[Effect of the Invention] According to this invention, incidence of S polarization and the P polarization is separately carried out to the skin, the both sides of S polarization component and P polarization component are received also as the reflected light from the skin to each incident light, and it becomes possible to facilitate the observation operation in the case of observing a skin front face so that a skin surface reflected light picture and the reflected light picture inside the skin can be acquired separately.

CLAIMS

[Claim(s)]

[Claim 1] The skin surface observation equipment carry out having image pck-up equipment which receives the reflected light of the light which carried out incidence to the skin from the irradiation means to which a skin front face can make carry out incidence of S polarization or the P polarization, and this irradiation means, receives the light which penetrated the liquid crystal cell which changes the polarization direction of the transmitted light by impression of voltage, and this liquid crystal cell, and receives the polarization component which penetrated the polarizing filter and this polarizing filter which make S polarization or polarization P penetrate as the feature.

[Claim 2] Skin surface observation equipment according to claim 1 with which an irradiation means consists of a polarizing filter for floodlighting which makes the cylinder-like lighting system which injects the light by which the light guide was carried out from the light source, S polarization, or P polarization penetrate.

[Claim 3] Skin surface observation equipment according to claim 1 or 2 with which an irradiation means consists of a liquid crystal cell which was prepared in the latter part of the cylinder-like lighting system which injects the light by which the light guide was carried out from the light source, the polarizing filter for floodlighting, and its polarizing filter for floodlighting, and which changes the polarization direction of the transmitted light by impression of voltage.

[Translation done.]

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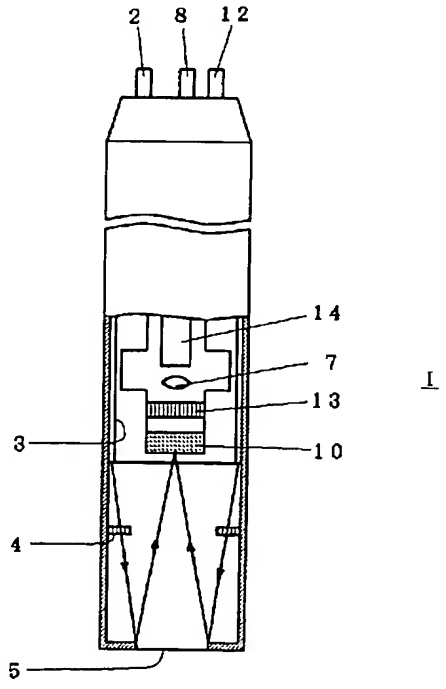
(71)出願人　000000918
花王株式会社
東京都中央区日本橋茅場町１丁目14番10号
(72)発明者　小島　伸俊
千葉県習志野市津田沼３－16－25－203
(72)発明者　堀田　肇
埼玉県幸手市東４－21－５
(74)代理人　弁理士　田治米　登　（外１名）

(54)【発明の名称】　皮膚表面観察装置

(57)【要約】
【目的】　皮膚にＳ偏光とＰ偏光を別個に入射させ、各入射光に対する皮膚からの反射光もＳ偏光成分とＰ偏光成分の双方を別個に受光し、皮膚表面を観察する場合の観察操作を簡便化する皮膚表面観察装置を得る。
【構成】　皮膚表面観察装置が、皮膚表面にＳ偏光又はＰ偏光を入射させることのできる照射手段、該照射手段から皮膚に入射させた光の反射光を受光し、電圧の印加により透過光の偏光方向が変わる液晶セル１０、該液晶セル１０を透過した光を受光し、Ｓ偏光又はＰ偏光を透過させる偏光フィルター１３、及び該偏光フィルター１３を透過した偏光成分を受光する撮像装置１４を有する。



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【特許請求の範囲】

【請求項1】　皮膚表面にS偏光又はP偏光を入射させることのできる照射手段、該照射手段から皮膚に入射させた光の反射光を受光し、電圧の印加により透過光の偏光方向が変わる液晶セル、該液晶セルを透過した光を受光し、S偏光又はP偏光を透過させる偏光フィルター及び該偏光フィルターを透過した偏光成分を受光する撮像装置を有することを特徴とする皮膚表面観察装置。

【請求項2】　照射手段が、光源から導光された光を射出する円筒状照明装置とS偏光又はP偏光を透過させる投光用偏光フィルターからなる請求項1記載の皮膚表面観察装置。

【請求項3】　照射手段が、光源から導光された光を射出する円筒状照明装置と、投光用偏光フィルターと、その投光用偏光フィルターの後段に設けられた、電圧の印加により透過光の偏光方向が変わる液晶セルからなる請求項1又は2に記載の皮膚表面観察装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、光の偏光特性を利用して、皮膚の小じわや毛穴等の表面反射光画像としみやそばかす等の皮膚内部の反射光画像とを別個に得、それに基づいて皮膚表面を解析評価するに際して好適な皮膚表面観察装置に関する。

【0002】

【従来の技術】肌にファンデーション等の化粧を施して所望の肌を得るためには、肌の質感（肌が観察者にどのように見えるかということ）と肌の物理的特性との対応関係や、化粧の種類や量と化粧を施した肌の物理的特性との対応関係を解析しておき、当該肌に施すべき化粧を定めることが有効である。そのため、従来より、皮膚表面の小じわや毛穴等の状態、あるいは皮膚内部のしみやそばかす等の色むらといった皮膚表面状態を解析し評価することが種々の方法でなされている。

【0003】この場合の方法としては、単に皮膚を拡大撮影し、その画像を基礎に皮膚表面状態を解析する方法もあるが、この方法では小じわや毛穴等の皮膚表面状態と、しみやそばかす等の皮膚内部状態とを分離して解析し評価することができない。そのため、小じわや毛穴等の状態をしみやそばかす等の色むらと別個に解析し評価できるようにするために、偏光を利用する方法が提案されている（特開平2－206426号公報等）。

【0004】即ち、図7に示すように、皮膚Sに自然光LI が入射すると、その一部は皮膚表面で反射し（表面反射光LS ）、他は皮膚内部へ屈折し、散乱、吸収を繰り返し、再度皮膚表面から出射する（内部反射光LD ）。この場合、表面反射光LSは皮膚表面の情報（凹凸情報、屈折率）をもち、内部反射光LD は皮膚内部の情報（肌の色、色むら）を有する。また、表面反射光LSは、入射した自然光LIが所定の偏光面を有する場合

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に、入射光LI と同じ偏光面の直線偏光として反射されるが、内部反射光LD は偏光性が失われたものとなる。

【0005】そこで、上述の特開平2－206426号公報においては、図6に示したように、装置内部の照射系と受光系にそれぞれ偏光フィルターを設けた皮膚表面観察装置を使用し、次のように皮膚表面を観察する。図6の装置においては、円筒状の本体1の内周壁に、光源から光ファイバー2により導光した光を射出するリング状照明装置3を有し、リング状照明装置3の先端前面には、同心円の中空部を有する円板形状の投光用偏光フィルター4が設けられている。また、本体1の先端部には観察孔部5が開けられており、本体1の先端近傍の中央には受光用偏光フィルター6が設けられており、この受光用偏光フィルター6の背後に拡大対物レンズ系7が設けられている。さらに拡大対物レンズ系7の後段に撮像装置（図示せず）が設けられ、撮像装置に受光された表面観察像が信号ケーブル8を通してモニターに出力されるようになっている。そしてこの場合、受光用偏光フィルター6は投光用偏光フィルター4に対して偏光方向が異なるようにする。この装置の使用時には、まず、観察孔部5に皮膚を当接させ、リング状照明装置3から投光用偏光フィルター4を通して皮膚に偏光を照射し、その反射光を受光用偏光フィルター6を通して撮像装置で受光し、皮膚の画像を形成する。このように皮膚表面を観察すると、投光用偏光フィルター4と受光用偏光フィルター6の偏光方向が異なっているので、撮像装置で受光される光は皮膚表面での直接反射光がカットされたものとなり、皮膚の画像が主に内部反射光に基づいて形成されるようになる。したがって、しみやそばかす等の状態が、投光用偏光フィルター4と受光用偏光フィルター6の偏光方向を同一にした場合よりも明瞭に得られるようになる。

【0006】

【発明が解決しようとする課題】しかしながら、従来の偏光を利用した皮膚表面の観察方法においては、上述の特開平2－206426号公報に記載の方法のように、一つの偏光方向の光のみに基づいて内部反射光に基づく画像を形成するので、得られる画像が実際の質感と異なり、得られた画像に基づいて皮膚を適確に解析し評価することができない場合があるという問題があった。

【0007】即ち、通常、光源として用いられる光は自然光である。自然光は非偏光であり、S偏光（入射面に垂直な振動面を有する偏光）とP偏光（入射面に平行な振動面を有する偏光）とを同じ強度で含み、観察者はこれら双方の反射光を受光し、皮膚の質感を感じ取ることとなる。一方、S偏光とP偏光との反射強度は入射角に応じて大きく異なり、例えば、特定の入射角ではS偏光は相当の反射率を示すがP偏光は全く反射されない。よって、S偏光あるいはP偏光の一方のみに基づいて形成した画像は実際に観察される画像と質感が異なることと

なる。

【０００８】これに対して、本発明者は、偏光を使用して皮膚表面を観察する方法として、皮膚へ入射させる光としてＳ偏光とＰ偏光の双方を使用し、それぞれの入射光に対する反射光をＳ偏光成分とＰ偏光成分の双方について別個に受光する方法を提案した（特願平５－２４７５２３号明細書、特許請求の範囲）。この方法によれば、自然光を入射光とした場合の皮膚の表面反射光成分と内部反射光成分とを算出でき、これにより実際の質感と等しい皮膚の表面反射光画像と内部反射光画像とを得られ、皮膚表面の特徴をより適格に解析評価することが可能となる。

【０００９】しかしながら、この方法においては、皮膚への入射光として２種の偏光を使用し、皮膚からの反射光として、各入射光のそれぞれについて２種の偏光成分を受光するので、合計４通りの入射光と反射光の組み合わせについて受光データを得ることが必要となる。そのために、図６に示した従来の装置でこの方法を実施する場合には、各受光データを得るたびに投光用偏光フィルター又は受光用偏光フィルターを付け替えるか向きを変えるといった機械的操作をしなくてはならない。よって、観察操作が非常に繁雑となるという問題があった。

【００１０】本発明はこのような従来技術の課題を解決しようとするものであり、皮膚表面の小じわや毛穴等の表面反射光画像としみやそばかす等の皮膚内部の反射光画像とを別個に得られるように皮膚表面を観察する方法として、皮膚にＳ偏光とＰ偏光を別個に入射させ、各入射光に対する皮膚からの反射光としてもＳ偏光成分とＰ偏光成分を別個に受光する場合に、一つの偏光方向を有する入射光に対する反射光のＳ偏光成分とＰ偏光成分とを、偏光フィルターの機械的操作をすることなく、それぞれ受光できるようにし、このような皮膚表面の観察方法を簡便に実施できるようにする皮膚表面観察装置を提供することを目的としている。

【００１１】

【課題を解決するための手段】本発明者らは、皮膚表面にＳ偏光又はＰ偏光を入射させた場合の反射光を受光するにあたり、電圧の印加によりの透過光の偏光方向が変わる液晶セルとＳ偏光成分又はＰ偏光成分の一方を透過させる液晶素子を使用すると上述の目的を達成できることを見出し、本発明を完成させるに至った。

【００１２】即ち、本発明は、皮膚表面にＳ偏光又はＰ偏光を入射させることのできる照射手段、該照射手段から皮膚に入射させた光の反射光を受光し、電圧の印加により透過光の偏光方向が変わる液晶セル、該液晶セルを透過した光を受光し、Ｓ偏光又はＰ偏光を透過させる偏光フィルター及び該偏光フィルターを透過した偏光成分を受光する撮像装置を有することを特徴とする皮膚表面観察装置を提供する。

【００１３】

【作用】本発明の皮膚表面観察装置においては、皮膚表面での反射光を、まず、電圧の印加により透過光の偏光方向が変わる液晶セルで受光し、この液晶セルを透過した光を偏光フィルターを通して撮像装置で受光する。したがって、この液晶セルとして、例えばＴＮセルを使用し、液晶セルへ電圧を印加した場合には、一つの偏光方向の入射光（例えば、Ｓ偏光の入射光）の皮膚での反射光のＳ偏光成分とＰ偏光成分とが本来の偏光方向を維持したまま液晶セルを透過し、偏光フィルターに入射し、偏光フィルターが所定の偏光成分（例えば、Ｓ偏光成分）を透過させ、その透過光が撮像装置で受光される。また、液晶セルへ電圧を印加しない場合には、液晶セルを透過した光は偏光方向が変わるので、例えば、皮膚での反射光のＳ偏光成分はＰ偏光成分となって液晶セルを透過し、反射光のＰ偏光成分はＳ偏光成分となって液晶セルを透過する。その後は、偏光フィルターを所定の偏光成分（例えば、Ｓ偏光成分）のみが透過し、その透過光が撮像装置で受光される。したがって、撮像装置で受光される光は、本来的には偏光フィルターを透過した偏光成分と異なる偏光方向を有する反射光成分（例えば、Ｐ偏光成分）となる。

【００１４】このように、本発明の皮膚表面観察装置によれば、撮像装置は、常に偏光フィルターで規定される所定の偏光方向（例えば、Ｓ偏光）の光を受光することとなるが、液晶セルへの電圧の印加の有無に応じて、本来的には反射光のＳ偏光成分又はＰ偏光成分のいずれも受光することができる。よって、反射光のＳ偏光成分とＰ偏光成分とを、偏光フィルターの機械的操作をすることなく、液晶セルへの電圧の印加の有無によるだけで、簡便に受光できるようになる。

【００１５】特に、Ｓ偏光又はＰ偏光を入射させることのできる照射手段として、光源から導光された光を射出する円筒状照明装置と、投光用偏光フィルターと、その投光用偏光フィルターの後段に電圧の印加により透過光の偏光方向が変わる液晶セルとを設けると、電圧の印加の有無により皮膚に入射させる偏光方向を変えることができる。したがって、入射光としてＳ偏光とＰ偏光の双方を使用し、それぞれの入射光に対する反射光をＳ偏光成分とＰ偏光成分の双方について別個に受光するという皮膚表面の観察方法を行うにあたり、装置内で偏光フィルターを付け替えあるいは向きの変更といった機械的操作を行うことが全く不要となり、観察操作が著しく簡便になる。

【００１６】

【実施例】以下、本発明の実施例を図面に基づいて具体的に説明する。なお、各図中、同一符号は同一又は同等の構成要素を表している。

【００１７】図１は、本発明の一実施例の装置Ｉ の部分切欠断面図であり、図２は、図１の装置を使用して皮膚表面観察を行うシステムの全体図である。

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【００１８】図１の装置Ⅰ には、照射手段として、図６に示した装置と同様に、円筒状の本体１の内周壁に、光源９から光ファイバー２により導光した光を射出するリング状照明装置３が設けられている。また、リング状照明装置３の先端前面には、同心円の中空部を有する円板形状の投光用偏光フィルター４が設けられており、本体１の先端部には観察孔部５が開けられている。

【００１９】本体１の先端近傍の中央には液晶セル１０が設けられており、この液晶セル１０の動作は、液晶セル制御部１１により制御用ケーブル１２を通して制御される。液晶セル１０としては、電圧の印加によりＳ偏光成分又はＰ偏光成分の一方を透過させるものを設ける。このような液晶セルとしては、例えば、ＴＮセル等を設けることができる。

【００２０】液晶セル１０の後段には偏光フィルター１３が設けられており、さらにその後段には、拡大対物レンズ系７、及び撮像装置としてＣＣＤカメラ１４が設けられている。このＣＣＤカメラ１４からの画像信号は、信号ケーブル８を通してＣＣＤカメラ制御部１５へ送られ、さらにその後段の画像処理部１６に入力される。この装置Ⅰ の使用に際しては、例えば、上述の特願平５－２４７５２３号明細書の特許請求の範囲に記載されている皮膚表面観察方法にしたがって、皮膚へＳ偏光とＰ偏光をそれぞれ入射させ、それぞれの入射光に対する反射光をＳ偏光成分とＰ偏光成分の双方について別個に受光することにより皮膚の表面観察を行う場合、まず、観察する皮膚にＳ偏光又はＰ偏光のいずれを照射するかに応じて投光用偏光フィルター４を適宜選択し所定の向きにセットする。そして、観察孔部５に皮膚を当接させ、リング状照明装置３から投光用偏光フィルター４を通して皮膚に所定の偏光（例えば、Ｐ偏光）を照射する。また、ＣＣＤカメラ１４で受光すべき偏光成分に応じ、液晶セル１０への所定の電圧の印加の有無を液晶セル制御部１１によって制御する。

【００２１】例えば、図３に示したように、投光用偏光フィルター４としてＰ偏光板を使用して皮膚Ｓにｐ偏光を入射させ、液晶セルの後段の偏光フィルター１３とし*

$$I(S)=(I(pp)-I(ps))+(I(ss)-I(sp)) \qquad (A)$$

また、皮膚に自然光を入射させた場合の内部反射光成分の強度I(D)を、次式（Ｂ）（特願平５－２４７５２３号明細書の式（１０））により求め、内部反射光画像を形※

$$I(D)=2\cdot I(ps)+2\cdot I(sp) \qquad (B)$$

図５の装置IIは、上述の図１の実施例において、照射手段を、光源から導光された光を射出する円筒状照明装置３と、投光用偏光フィルター４と、電圧の印加により透過光の偏光方向が変わる液晶セル１７から構成した場合の変形例である。このような液晶セルとしては、ＴＮセル等を使用することができる。この照射手段において、例えば、液晶セル１７としてＴＮセルを使用し、投光用偏光フィルター４としてＳ偏光又はＰ偏光を透過させる★

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*てもＰ偏光フィルターを使用した場合に、ＣＣＤカメラ１４で皮膚Ｓからの反射光のＰ偏光成分を受光しようとする場合には、液晶セル（ＴＮセル）１０へ所定の電圧を印加し、液晶セル１０を透過した光が液晶セルへ入射した光と同一偏光面を有するようにする。これにより、皮膚Ｓでの反射光は、Ｓ偏光成分もＰ偏光成分もその偏光方向を維持したまま液晶セル１０を透過して、偏光フィルター１３に入射し、Ｐ偏光成分のみが偏光フィルター１３を透過し、ＣＣＤカメラ１４で受光されるようになる。一方、同様の装置構成においてＣＣＤカメラ１４で皮膚Ｓからの反射光のＳ偏光成分を受光しようとする場合には、図４に示したように、液晶セル（ＴＮセル）１０への電圧の印加を停止し、液晶セル１０を透過した光が液晶セルへ入射した光と異なる偏光面（例えば９０°回転した方向の偏光面）を有するようにする。これにより、皮膚Ｓでの反射光のうちＳ偏光成分は、液晶セル１０の透過後にはＰ偏光となり、Ｐ偏光成分は、液晶セル１０の透過後にはＳ偏光となって偏光フィルター１３に入射する。そして、Ｐ偏光（反射光の本来のＳ偏光成分）のみが偏光フィルター１３を透過し、ＣＣＤカメラ１４で受光されるようになる。このようにして、皮膚ＳにＰ偏光を照射し、その場合の反射光のＳ偏光成分I(ps)とＰ偏光成分I(pp)の受光データを得る。

【００２２】また、以上のような操作を、投光用偏光フィルター４がＳ偏光板となるようにして繰り返すことにより、皮膚にＳ偏光を照射した場合の反射光のＳ偏光成分I(ss)とＰ偏光成分I(sp)の受光データも得る。

【００２３】ＣＣＤカメラ１４は偏光フィルター１３を透過した光を受光すると、その画像信号を画像処理部１６に入力する。画像処理部１６では、こうして得られた４種受光データI(ss)、I(sp)、I(ps)、I(pp)に基づき、皮膚Ｓに自然光を入射させた場合の表面反射光成分の強度I(S)を、次式（Ａ）（特願平５－２４７５２３号明細書の式（９））により求め、表面反射光画像を形成する。

【００２４】

【数１】

※成する。

【００２５】

【数２】

★ものを使用すると、液晶セル１７に電圧を印加しない場合には、皮膚に照射される光の偏光方向は投光用偏光フィルター４と９０°回転した方向となるが、電圧を印加すると投光用偏光フィルター４と同一方向となる。したがって、皮膚にＳ偏光を照射するか又はＰ偏光を照射するかに応じて投光用偏光フィルター４を付け替えるかあるいは向きを変える等の機械的操作をしなくても、液晶セル１６への印加電圧のｏｎ、ｏｆｆにより皮膚へＳ偏

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光、Ｐ偏光のいずれも照射することが可能となる。よって、皮膚へＳ偏光とＰ偏光をそれぞれ入射させ、それぞれの入射光に対する反射光をＳ偏光成分とＰ偏光成分の双方について受光することにより皮膚の表面観察を行う場合の観察操作を、より一層簡便に、精度よく行うことが可能となる。

【００２６】なお、以上の実施例においては、皮膚表面の小じわや毛穴等の表面反射光画像としみやそばかす等の皮膚内部の反射光画像とを別個に得るための皮膚表面観察に本発明の装置を適用する場合を説明したが、本発明の装置はこれに限られず種々の皮膚の表面観察に使用することができる。特に、被観察物が動きやすいために、４種の受光データI(ss)、I(sp)、I(ps)、I(pp)を個別に測定することが困難な場合の観察装置として好適に使用することができ、例えば胃カメラなどの医療用カメラとして使用することができる。

【００２７】

【発明の効果】本発明によれば、皮膚表面反射光画像と皮膚内部の反射光画像とを別個に得られるように、皮膚にＳ偏光とＰ偏光を別個に入射させ、各入射光に対する皮膚からの反射光としてもＳ偏光成分とＰ偏光成分の双方を受光し、皮膚表面を観察する場合の観察操作を簡便化することが可能となる。

【図面の簡単な説明】

【図１】本発明の一実施例の装置の部分切欠断面図である。

【図２】実施例の装置を使用して皮膚表面観察を行うシステムの全体図である。

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【図３】実施例の装置の作用の説明図である。

【図４】実施例の装置の作用の説明図である。

【図５】本発明の他の実施例の装置の部分切欠断面図である。

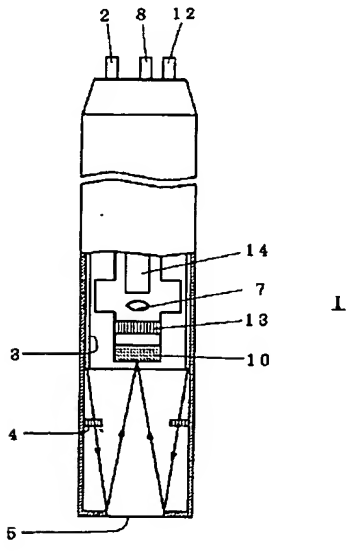
【図６】従来の皮膚表面観察装置の部分切欠断面図である。

【図７】皮膚に自然光が入射した場合の表面反射と内部反射の説明図である。

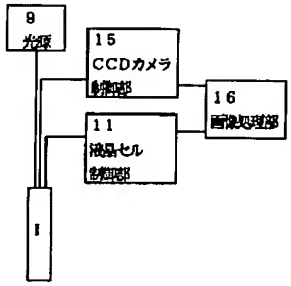
【符号の説明】

1	本体
2	光ファイバー
3	リング状照明装置
4	投光用偏光フィルター
5	観察孔部
6	受光用偏光フィルター
7	対物レンズ系
8	信号ケーブル
9	光源
１０	液晶セル
１１	液晶セル制御部
１２	制御用ケーブル
１３	偏光フィルター
１４	ＣＣＤカメラ
１５	ＣＣＤカメラ制御部
１６	画像処理部
１７	液晶セル
I	実施例の装置
II	実施例の装置

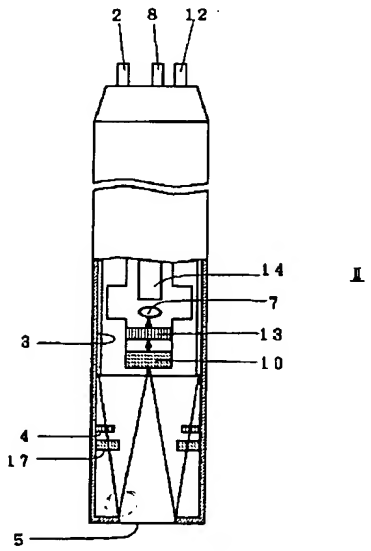
【図１】



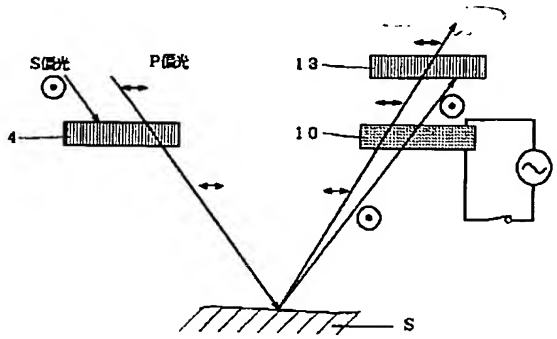
【図２】



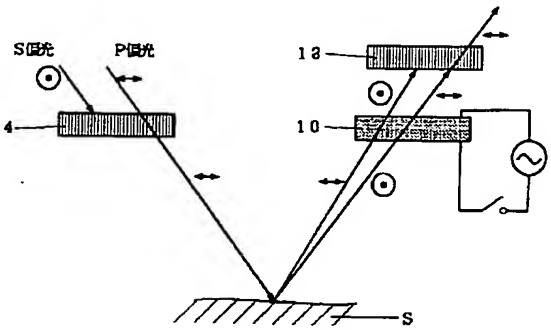
【図５】



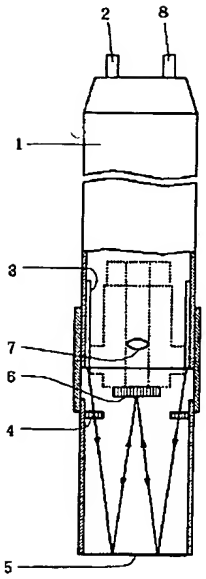
【図3】



【図4】



【図6】



【図7】